

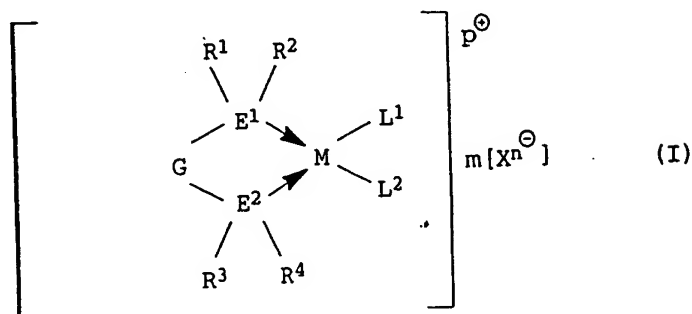
We claim:-

1. A catalyst system for the copolymerization of carbon monoxide and  $\alpha$ -olefinically unsaturated compounds, containing, as essential components,

a) a metal complex of the formula (I)

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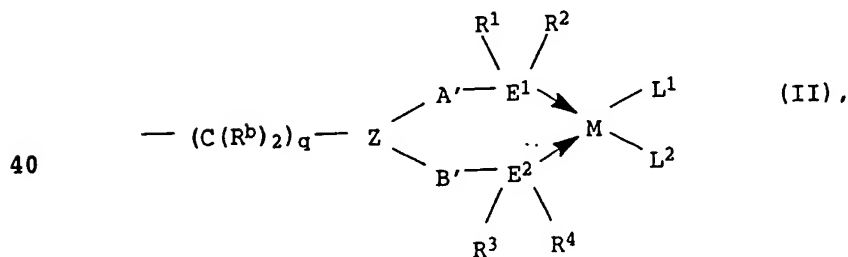
where

G is  $-(CR^b)_r-$ ,  $-(CR^b)_s-Si(R^a)_2-(CR^b)_t-$ ,  $-A'-O-B'-$  or  $-A'-Z(R^5)-B'-$

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R<sup>5</sup> is hydrogen, or is C<sub>1</sub>- to C<sub>28</sub>-alkyl, C<sub>3</sub>- to C<sub>14</sub>-cycloalkyl, C<sub>6</sub>- to C<sub>15</sub>-aryl or alkylaryl where the alkyl radical is of 1 to 20 carbon atoms and the aryl radical is of 6 to 15 carbon atoms, each of which is unsubstituted or substituted by functional groups based on the elements of groups IVA, VA, VIA or VIIA of the Periodic Table of Elements, or is  $-N(R^b)_2$ ,  $-Si(R^c)_3$  or a radical of the formula II

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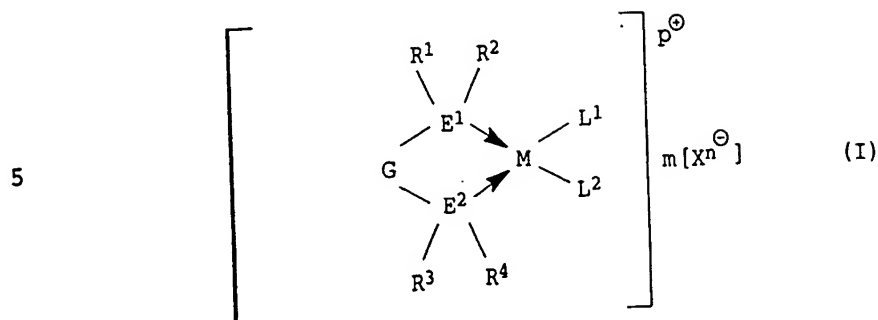
where

- q is an integer from 0 to 20 and the further substituents in (II) have the same meanings as in (I),
- 5 A' and B' are each  $-(CR^{b_2})_{r'-}$ ,  $-(CR^{b_2})_s-Si(R^a)_2-(CR^{b_2})_{t-}$ ,  $-N(R^b)-$ , an  $r'-$ ,  $s-$  or  $t-$  atom component of a ring system or, together with Z, an  $(r'+1)-$ ,  $(s+1)-$  or  $(t+1)-$  atom component of a heterocyclic structure,
- 10  $R^a$  independently of one another, are each  $C_1-$  to  $C_{20}$ -alkyl,  $C_3-$  to  $C_{10}$ -cycloalkyl,  $C_6-$  to  $C_{15}$ -aryl or alkylaryl where the alkyl moiety is of 1 to 10 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms,
- 15  $R^b$  is the same as  $R^a$  or is hydrogen or  $Si(R^c)_3$ ,
- 20  $R^c$  is  $C_1-$  to  $C_{20}$ -alkyl,  $C_3-$  to  $C_{10}$ -cycloalkyl,  $C_6-$  to  $C_{15}$ -aryl or alkylaryl where the alkyl moiety is of 1 to 10 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms,
- 25 r is 1, 2, 3 or 4
- $r'$  is 1 or 2,
- s and t are each 0, 1 or 2, where  $1 \leq s+t \leq 3$
- 30 Z is a nonmetallic element from group VA of the Periodic Table of Elements,
- 35 M is a metal selected from the group VIIIB, IB or IIB of the Periodic Table of Elements,
- $E^1$  and  $E^2$  are each a nonmetallic element from group VA of the Periodic Table of Elements,
- 40  $R^1$  to  $R^4$  are each linear or branched  $C_2-$  to  $C_{28}$ -alkyl,  $C_3-$  to  $C_{14}$ -cycloalkyl or alkylaryl where the alkyl moiety is of 1 to 28 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms, each of which
- 45 is substituted by at least one polar protic or ionic functional group based on elements of groups

## IVA to VIA of the Periodic Table of Elements,

- $L^1$  and  $L^2$  are formally charged or neutral ligands,
- 5  $X$  are formally monovalent or polyvalent anions,
- $p$  is 0, 1, 2, 3 or 4,
- 10  $m$  and  $n$  are each 0, 1, 2, 3 or 4,
- and  $p = m \times n$ ,
- 15 and
- b) if required, one or more Lewis or protic acids or a mixture of Lewis and protic acids.
- 20 2. A catalyst system as claimed in claim 1, wherein  $R^1$  to  $R^4$  are linear, branched or carbocycle-containing  $C_2$ - to  $C_{28}$ -alkyl units or  $C_3$ - to  $C_{14}$ -cycloalkyl units which have at least one terminal or internal hydroxyl, amino acid, carboxyl, phosphoric acid, ammonium or sulfo group, or alkylaryl where
- 25 the alkyl moiety is of 1 to 28 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms, the alkyl or aryl moiety being substituted by at least one hydroxyl, amino acid, carboxyl, phosphoric acid, ammonium or sulfo group.
- 30 3. A catalyst system as claimed in claim 1 or 2, wherein the Lewis acid used is boron trifluoride, antimony pentafluoride or a triarylborane and the protic acid used is sulfuric acid, p-toluenesulfonic acid, tetrafluoroboric acid,
- 35 trifluoromethanesulfonic acid, perchloric acid or trifluoroacetic acid.
4. A catalyst system for the copolymerization of carbon monoxide and  $\alpha$ -olefinically unsaturated compounds as claimed in claim 1, containing, as an essential component, a metal complex of
- 40 the formula (I)

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where

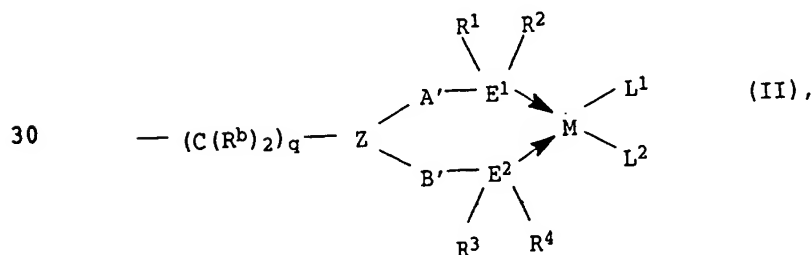
G is  $-(CR^b_2)_r-$ ,  $-(CR^b_2)_s-Si(R^a)_2-(CR^b_2)_t-$ ,  $-A'-O-B'-$  or  $-A'-Z(R^5)-B'-$ ,

15

R<sup>5</sup> is hydrogen or is C<sub>1</sub>- to C<sub>28</sub>-alkyl, C<sub>3</sub>- to C<sub>10</sub>-cycloalkyl, C<sub>6</sub>- to C<sub>15</sub>-aryl or alkylaryl where the alkyl radical is of 1 to 20 carbon atoms and the aryl radical is of 6 to 15 carbon atoms, each of which is unsubstituted or substituted by functional groups based on the elements of groups IVA, VA, VIA or VIIA of the Periodic Table of Elements, or is  $-N(R^b)_2$ ,  $-Si(R^c)_3$  or a radical of the formula Formel II

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where

q is an integer from 0 to 20 and the further substituents in (II) have the same meanings as in (I),

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A' and B' are each  $-(CR^b_2)_r-$  or  $-(CR^b_2)_s-Si(R^a)_2-(CR^b_2)_t-$  or  $-N(R^b)-$ , an r'-, s- or t-atom component of a ring system or, together with Z, an (r'+1)-, (s+1)- or (t+1)-atom component of a heterocyclic structure,

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- 5         $R^a$         independently of one another, are each  $C_1$ - to  $C_{20}$ -alkyl,  $C_3$ - to  $C_{10}$ -cycloalkyl,  $C_6$ - to  $C_{15}$ -aryl or alkylaryl where the alkyl moiety is of 1 to 10 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms,
- $R^b$         is the same as  $R^a$  or is hydrogen or  $Si(R^c)_3$ ,
- 10        $R^c$         is  $C_1$ - to  $C_{20}$ -alkyl,  $C_3$ - to  $C_{10}$ -cycloalkyl,  $C_6$ - to  $C_{15}$ -aryl or alkylaryl where the alkyl moiety is of 1 to 10 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms,
- 15        $r$         is 1, 2, 3 or 4 and
- $r'$         1 or 2,
- 20        $s$  and  $t$     are each 0, 1 or 2, where  $1 \leq s+t \leq 3$
- $Z$         is a nonmetallic element from group VA of the Periodic Table of Elements,
- 25        $M$         is a metal selected from the group VIIIB, IB or IIB of the Periodic Table of Elements,
- 30        $E^1$  and  $E^2$  are each a nonmetallic element from group VA of the Periodic Table of Elements,
- 35        $R^1$  to  $R^4$  are each linear or branched  $C_2$ - to  $C_{28}$ -alkyl,  $C_3$ - to  $C_{14}$ -cycloalkyl or alkylaryl where the alkyl moiety is of 1 to 28 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms, each of which is substituted by at least one polar protic or ionic functional group based on elements of groups IVA to VIA of the Periodic Table of Elements,
- 40        $L^1$  and  $L^2$  are formally charged or neutral ligands,
- $X$         are formally monovalent or polyvalent anions,
- 45        $p$         is 0, 1, 2, 3 or 4,
- $m$  and  $n$     are each 0, 1, 2, 3 or 4,

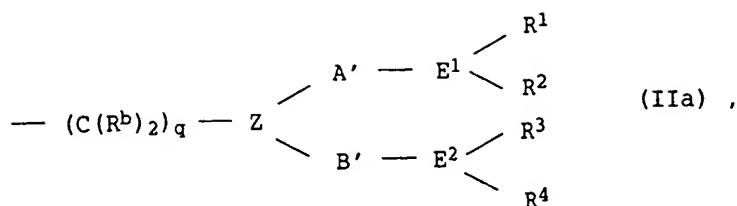
and  $p = m \times n$ ,

and no external protic or Lewis acid b).

5. The use of a catalyst system as claimed in any of claims 1 to 4 for the preparation of linear, alternating copolymers of carbon monoxide and  $\alpha$ -olefinically unsaturated compounds in an aqueous medium.
6. A process for the preparation of linear, alternating copolymers of carbon monoxide and  $\alpha$ -olefinically unsaturated compounds, wherein the copolymerization is carried out in an aqueous medium in the presence of a catalyst system as claimed in claims 1 to 4.
7. A process for the preparation of linear, alternating copolymers of carbon monoxide and  $\alpha$ -olefinically unsaturated compounds, wherein the monomers are copolymerized in an aqueous medium in the presence
  - i) of a metal M selected from the group VIIIB, IB or IIB of the Periodic Table of Elements, which is present in salt form or as a complex salt,
  - ii) a chelate ligand of the formula (III)  
 $(R^1)(R^2)E^1-G-E^2(R^3)(R^4)$ , where
 

G is  $-(CR^{b_2})_r-$ ,  $-(CR^{b_2})_s-Si(R^a)_2-(CR^{b_2})_t-$ ,  $-A'-O-B'-$  or  $-A'-Z(R^5)-B'-$ ,

$R^5$  is hydrogen or is  $C_1-$  to  $C_{28}$ -alkyl,  $C_3-$  to  $C_{14}$ -cycloalkyl,  $C_6-$  to  $C_{15}$ -aryl or alkylaryl where the alkyl radical is of 1 to 20 carbon atoms and the aryl radical is of 6 to 15 carbon atoms, each of which is unsubstituted or substituted by functional groups based on the elements of groups IVA, VA, VIA or VIIA of the Periodic Table of Elements, or is  $-N(R^b)_2$ ,  $-Si(R^c)_3$  or a radical of the formula IIa)



where

- 10  $q$  is an integer from 0 to 20 and the further substituents in (IIa) have the same meanings as in (III),
- 15  $A'$  and  $B'$  are each  $-(CR^b_2)_r-$ ,  $-(CR^b_2)_s-Si(R^a)_2-(CR^b_2)_t-$ ,  $-N(R^b)-$ , an  $r'$ -,  $s$ - or  $t$ -atom component of a ring system or, together with  $Z$ , an  $(r'+1)-$ ,  $(s+1)-$  or  $(t+1)-$ atom component of a heterocyclic structure,
- 20  $R^a$  independently of one another, are each  $C_1-$  to  $C_{20}$ -alkyl,  $C_3-$  to  $C_{10}$ -cycloalkyl,  $C_6-$  to  $C_{15}$ -aryl or alkylaryl where the alkyl moiety is of 1 to 10 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms,
- 25  $R^b$  is the same as  $R^a$  or is hydrogen or  $Si(R^c)_3$ ,
- 30  $R^c$  is  $C_1-$  to  $C_{20}$ -alkyl,  $C_3-$  to  $C_{10}$ -cycloalkyl,  $C_6-$  to  $C_{15}$ -aryl or alkylaryl where the alkyl moiety is of 1 to 10 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms,
- 35  $r$  is 1, 2, 3 or 4,
- $r'$  is 1 or 2,
- $s$  and  $t$  are each 0, 1 or 2, where  $1 \leq s+t \leq 3$
- 40  $Z$  is a nonmetallic element from group VA of the Periodic Table of Elements,
- 45  $E^1$  and  $E^2$  are each a nonmetallic element from group VA of the Periodic Table of Elements, and

R<sup>1</sup> to R<sup>4</sup> are each linear or branched C<sub>2</sub>- to C<sub>28</sub>-alkyl, C<sub>3</sub>- to C<sub>14</sub>-cycloalkyl or alkylaryl where the alkyl moiety is of 1 to 28 carbon atoms and the aryl moiety is of 6 to 15 carbon atoms, each of which is substituted by at least one polar protic or ionic functional group based on elements of groups IVA to VIA of the Periodic Table of Elements,

and

iii) if required, one or more Lewis or protic acids or a mixture of Lewis and protic acids.